

A comparative study of the adults and larvae of Xylophilidae and 32 other families of Cucujoidea (Coleoptera)

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Abstract

Following the discovery of larvae of *Xylophilidae* (= *Aderidae* or *Euglenidae*) in Japan, the author has reviewed the family presenting a comparative account of 44 larval characters and 67 imaginal characters (including fossils) in the world families of *Heteromera Cucujoidea*, indicating the existing gaps in our knowledge and suggesting the research problems still to be solved in order to discover or understand the phylogeny of *Xylophilidae*. Taxonomic keys for the identification of British, American and Canadian *Xylophilidae* are also included.

Introduction

The heteromerous beetle family Xylophilidae Latreille, 1825 (with the following junior synonyms: Aderidae Winkler, 1924; ? Circaeidae Yablokoff-Khnzorian, 1960; Euglenidae Pic, 1900; and Hylophilidae Westwood, 1829) is still in need of systematic revision for the world; the primitive and derivative groups and character states, the direction in which the transformation series is to be read, as well as the phylogenetic classification remains

to be discovered at all taxonomic levels (species and above) despite the general system proposed by Báguena-Corella (1948 and 1962) inspired by Casey (1895) and accepted (Nomura, 1964) or rejected (Pic, vide Báguena-Corella, 1962: 6) or ignored by others (Buck, 1954; Kaszab, 1969, etc). One of several major criticisms of Báguena-Corella's work is that "Some of the genera, not to speak of the bulk of the species, seem to have been known by Báguena only by the old descriptions often very unsatisfactory indeed. This was bound to cause inconsistencies" (Israelson, 1971: 109).

The larvae of a Japanese Xylophilid, *Escalerosia rubrivestis* (Marseul, 1876) based on 12 specimens living in rotten wood, and collected between April 30 — May 5 were recently described by Hayashi (1972 with 13 figures) which will be considered below; other useful scientific literature on the family is listed in the bibliography.

I must warn the reader that the larvae and adults of primitive members (of a sub-species, species, sub-genus, genus, sub-tribe, tribe, sub-family, family, section, superfamily, series or infra-orders, and suborders) of the insect order Coleoptera (including Strepsiptera) are much more important and decisive as indicators of phylogenetic relationships, ancestry, homology, the direction in which a transformation series is to be read, etc. than the immature or adult stages of derivative groups (for any order of insects or other animals, and plants) at any level in a natural or phylogenetic classification (vide Abdullah, 1972, 1973 a—j and 1974 a, b). The primitive and derivative members, groups and characters of Xylophilidae still remain to be discovered (Abdullah, 1973 i); and these comments are offered here mainly for the guidance of those students who wish to solve this outstanding problem in coleopterology. Any discussion on phylogeny of Xylophilidae is premature and quite inconclusive at this stage, and is therefore omitted here.

Characters of Larvae

The larvae of the primitive groups of Anthicidae (Pedilinae and Steropinae) are not known to science, and even this is not known as to what are the natural groups within Xylophilidae and what are the primitive and derivative groups. It can not be decided, under the circumstances, as to whether any similarity in structure between Xylophilidae and Anthicidae is due to homology (true or phylogenetic relationship) or convergence. Obviously, one of the two possibilities will prove to be wrong in the future. A comparative account of the larvae of Xylophilidae and other Heteromera (Cucujoidea) follows:

1. **Mode of life, habits and food.** The only known larva of a species of Xylophilidae (*Escalerosia rubrivestis* — vide: Hayashi, 1972) was discovered in rotten wood (= xylophagous) in Japan. It is not known if this was predaceous on other xylophagous larvae as are *Anaspis* larvae (Scraptiidae) and *Anthicus* larvae (Anthicidae) — all of which look superficially rather similar (vide Abdullah, 1973 i).

2. **Shape.** Xylophilid larva is strikingly flattened and markedly expanded caudally. Strongly to moderately depressed forms are also known in Boridae, Hemimeplidae (including Mycteridae), Inopeplidae, a few Mycetophagidae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, and Salpingidae. However, known Anthicid larvae are orthosomatic and their body is not depressed as are also the larval forms of Byturidae, Cisidae or Ciidae, Colydiidae, Melandryidae, Monommidae, most Mycetophagidae, Oedemeridae, Perimylopidae, Tenebrionidae (including Alleculidae, Lagriidae and Petriidae), Tetratomidae and Zopheridae (Abdullah, 1973 i).

3. **Size.** The known mature or full grown Xylophilid larva is about 6 mm (adults of the family are usually 1.5 to 3 mm) in length. Almost always the full grown larva of a family is longer than the adult of the same species; for examples, see Abdullah (1973 i).

4. **Coloration.** The known Xylophilid larva is nearly white as are also the larvae in Anthicidae (becoming yellowish-white to brown), Cephaloidae, Cisidae, Mordellidae, Oedemeridae, Othniidae, Prostomidae, Salpingidae, some Tenebrionidae (to nearly black), but in other families they are usually pigmented or sclerotized (vide Abdullah, 1973 i).

5. **Vestiture, setae (chaetotaxy).** The known Xylophilid larva bears a few long setae on lateral sides of body; microtrichia are distributed longitudinally on the epipharynx; many microtrichia exist on the hypopharynx; and ninth abdominal segment ends in small urogomphi. Before the value of the characters of chaetotaxy can be assessed usefully, one needs to know the extent of variation: intraspecific as well as interspecific (vide Abdullah, 1973 i).

6. **Head-capsule** in the known Xylophilid larva is strongly depressed, lateral sides are evenly rounded, hind margin is wavy, undulated or emarginate from above, and seems to be (?) prognathous and is nearly as wide or broad as the prothorax. Known Anthicid larval heads are only slightly depressed, quadrangular in shape, slightly narrower than prothorax and clearly exserted and prognathous. The head is prognathous in Byturidae, Cephaloidae, Cisidae, Colydiidae, Melandryidae, Meloidae (first instars),

Monommidae, most Mycetophagidae, Oedemeridae, Pythidae and others; but in Mordellidae, Othniidae and Pyrochroidae, the head is hypognathous (vide Abdullah, 1973 i).

7. *Coronal suture and frontal sutures*, latter lyriiform or not (together = median epicranial suture). In the known Xylophilid larva the coronal suture is absent (unlike Anthicids) and the 2 frontal sutures are lyre-shaped or lyrate (as in *Anthicus* but less so in *Notoxus* of Anthicidae). The coronal suture is present in Boridae, Cephaloidae, some Cisidae, some Colydiidae, Hemi-peplidae, Inopeplidae, Meloidae (first instars), Monommidae, Mordellidae (*Tomoxia*), some Mycetophagidae, Nilionidae, Oedemeridae, some Othniidae, Perimylopidae, some Pyrochroidae, some Pythidae, Salpingidae, some Scaptiidae, Syndroidae, Tenebrionidae, Tetratomidae, and some Zopheridae. The frontal sutures are lyriiform in all families of Heteromera for which the larvae are known except the following: some Cisidae, some Colydiidae, some Hemi-peplidae, some Melandryidae, some first instar Meloidae, some Oedemeridae, and Tenebrionidae (V- or U-shaped) (vide Abdullah, 1973 i & j).

8. *Clypeal or epistomal or frontoclypeal suture*. This suture is absent in the known Xylophilid larva so that the frons and clypeus are fused or confluent, as is also the case in the following Heteromera: Anthicidae, Boridae, Cephaloidae, some Colydiidae, Inopeplidae, some Melandryidae, first instar Meloidae, Mycetophagidae, some Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, some Salpingidae, Scaptiidae, Syndroidae, and Tetratomidae. On the other hand, the frontoclypeal suture is present and the clypeus is posteriorly delimited in Byturidae, Cisidae, some Colydiidae, Hemi-peplidae, some Melandryidae, Monommidae, Mordellidae, Nilionidae, Oedemeridae, some Othniidae, ? some Pythidae, some Salpingidae, Tenebrionidae and Zopheridae (vide Abdullah, 1973 i & j).

9. *Clypeolabral suture*. This suture is present in the known Xylophilid larva as well as most Heteromera (except perhaps some Meloidae and Rhipiphoridae). A distinct labrum is also visible from above in Anthicidae (Abdullah, 1973 i & j).

10. *Epipharynx*. This is characterized by the longitudinally distributed microtrichia and the unisetiferous sensillae which are not on the same level, and are located near the base in the known Xylophilid larva. Characteristic epipharynges are also known for Anthicidae, Boridae, Inopeplidae, Melandryidae, Othniidae, Prostomidae, Pythidae, Salpingidae, Tenebrionidae and others, but details remain to be described in most cases (vide Abdullah, 1973 i).

11. *Hypostomal margins or rods*. These structures are neither described nor figured in the known *Xylophilid* larva (Hyashi, 1972) but the possibility of their being omitted from consideration is not entirely ruled out. This ventral marginal thickening of each of the epicranial halves between the articulation of the ventral mandibular condyle and the ventral tentorial pit is present in the following families of *Heteromera*: Anthicidae, Byturidae, Cephaloidae, Cisidae, Colydiidae, Hemi-peplidae, Inopeplidae, some Melandryidae, Monommidae, Mordellidae, Mycetophagidae, Nilionidae, some Oedemeridae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, Scaptiidae, Synchronidae, some Tenebrionidae, some Tetratomidae, and Zopheridae. On the other hand, the rods are absent in ? Boridae, some Melandryidae, some Oedemeridae, Perimylopidae, ? Rhipiphoridae, some Tenebrionidae, and some Tetratomidae (vide Abdullah, 1973 i & j).

12. *Hypopharyngeal sclerome*. This structure is heavily sclerotized and forms a transverse trapezoid in the known *Xylophilid* larva, and is known to be present in the *Heteromera* as follows: Anthicidae, Boridae, Byturidae, Cephaloidae, some Colydiidae, some Melandryidae, Monommidae, Mycetophagidae, Nilionidae, Oedemeridae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, some Salpingidae, some Scaptiidae, Synchronidae, most Tenebrionidae, some Tetratomidae, and Zopheridae. On the other hand, the sclerome is absent in Cisidae, some Colydiidae, Hemi-peplidae, Inopeplidae, some Melandryidae, Perimylopidae, some Salpingidae, some Scaptiidae, a few Tenebrionidae, and some Tetratomidae (vide Abdullah, 1973 i & j).

13. *Ocelli*. There are no ocelli in the known *Xylophilid* larva and the presence (+), exact numbers or conditions doubtful or unknown (?) in other *Heteromera* are as follows: Anthicidae 2; Boridae +; Byturidae 10 to 12; Cephaloidae 12; Cisidae 0; Colydiidae 10 or 0; Dacoderidae?; Hemi-peplidae 10 or 4; Inopeplidae 8; Lagriinae-Tenebrionidae 10 or 8; Melandryidae 6 to 10; first instar Meloidae 2 to 4; Monommidae 10; Mordellidae 0 to 2; Mycetophagidae 8 to 12; Nilionidae +; Oedemeridae 0; Othniidae 10 or 2; Perimylopidae 10; Pterogeniidae?; Pyrochroidae 8 to 10; Pythidae 10; first instar Rhipiphoridae +, ? 10; Salpingidae 10; Scaptiidae 4; Synchronidae? 10; Tenebrionidae 8 to 0; Tetratomidae 10; Trictenotomidae?; and Zopheridae 0 or ? + (vide Abdullah, 1973 i & j).

14. *Sensory appendix or sensorium or tactile papilla or accessory process of antenna*. The sensory appendage of the second antennal segment is well-developed and cone-shaped in the known *Xylophilid* larva. Sensoria are present in the following *Heteromera* also: Anthicidae, Boridae, Byturidae, Cephaloidae, Cisidae, Coly-

diidae (but on antennal segment 1 in *Bothrideres* !), Hemipeplidae, Inopeplidae, some Melandryidae, some first instar Meloidae, Mycetophagidae, ? Oedemeridae, Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, some Scaptiidae, some Tenebrionidae, Tetratomidae, and Zopheridae. On the other hand, the sensoria are not recorded in Alleculinae-Tenebrionidae, some Melandryidae, some first instar Meloidae, Monommidae, ? Mordellidae, Nilionidae, some Scaptiidae, ? Synchroidae, and some Tenebrionidae (vide Abdullah, 1973 i & j).

15. Third antennal segment more than half longer than second or less. The third antennal segment is about $2/3$ rd as long as the second segment, and the apical seta or hair is distinctly longer than antenna in the known Xylophilid larva. The third antennal segment although usually short in comparison with second segment is also more than half longer than it in some Anthicidae, Byturidae, Cephaloidae, some Colydiidae, Hemipeplidae, Inopeplidae, Melandryidae, some first instar Meloidae, Monommidae, Mordellidae, some Mycetophagidae, some Othniidae, Prostomidae, Pyrochroidae, some Pythidae, Rhipiphoridae, Salpingidae, Tetratomidae and Zopheridae. On the other hand, the third segment (if present) is less than half or upto half in length of the second segment of the antenna in Alleculinae-Tenebrionidae, some Anthicidae, Boridae, Cisidae, some Colydiidae, Lagriinae-Tenebrionidae, some first instar Meloidae, some Mycetophagidae, Oedemeridae, some Othniidae, Perimylopidae, some Pythidae, Scaptiidae, Synchroidae, and Tenebrionidae (vide Abdullah, 1973 i & j).

16. Number of antennal segments. In most Heteromera, including Xylophilidae, there are 3 segments per antenna. Less than 3 segments are recorded for Nilionidae (2), some Lagriinae-Tenebrionidae, and 3 to vestigial is reported for Mordellidae (vide Abdullah, 1973 i & j).

17. Antennal insertion separated from base of mandible by a visible strip of head capsule or not. This characters has not been described for Xylophilidae or Anthicidae, and in both families the published figures suggest rather inconclusively that the insertions are not separated, which needs to be verified, as is also the case with some other Heteromera (vide Abdullah, 1973 i & j).

18. Mandibles symmetrical or asymmetrical. The mandibles are clearly asymmetrical in the known Xylophilid larva; a retinaculum is distinct on the left mandible only, and the apex is tri-dentate on the right side but the tooth of the dorsal cutting edge of the left mandible is rather obsolete. Asymmetrical mandibles are also recorded in Alleculinae-

Tenebrionidae, some Anthicidae, ? Boridae, some Cephaloidae, Cisidae, some Lagriinae-Tenebrionidae, some Melandryidae, Mycetophagidae, Nilionidae, some Oedemeridae, some Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, some Scaptiidae, Synchroidae, Tenebrionidae, and some Tetratomidae. But they are asymmetrical in all known Byturidae, Colydiidae, ? Hemipeplidae, Inopeplidae, first instar Meloidae, Monommidae, and ? Zopheridae. Some members of the following families also have symmetrical mandibles: Anthicidae, Cephaloidae, Lagriinae-Tenebrionidae, Melandryidae, Scaptiidae, and Tetratomidae (vide Abdullah, 1973 i & j).

19. *Mandibular mola present or absent.* A molar part is well-developed in the known Xylophilid larva as well as in the following remaining Heteromera: Alleculinae-Tenebrionidae, Anthicidae, Boridae, Byturidae, Cephaloidae, Hemipeplidae, Inopeplidae, Langriinae-Tenebrionidae, Mycetophagidae, Nilionidae, Oedemeridae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, Scaptiidae, Synchroidae, Tenebrionidae, and Zopheridae. On the other hand, there is no mola or ridged or roughened grinding surface near the base of mesal surface of a mandible in Cisidae, first instar Meloidae, Mordellidae, Perimylopidae, and Rhipiphoridae. Both the presence or absence of a mandibular mola is recorded in Colydiidae, Melandryidae, Monommidae, Salpingidae, and Tetratomidae (vide Abdullah, 1973 i & j).

20. *Mandibular mola asperate* (roughened or with tubercles but not ridged). The mola are not asperate in the known Xylophilidae or Anthicidae and most Heteromera. The known exceptions are: Colydiidae, Mycetophagidae, most Prostomidae, some Tetratomidae, and ? *Prostominia*, Othniidae (vide Abdullah, 1973 i & j).

21. *Mandibular mola with the armament extending ventrally or not.* The armament is not ventral in the known Xylophilidae or Anthicidae and most Heteromera, with the exceptions of known Colydiidae, Mycetophagidae, Prostomidae (? some), and some Tetratomidae (vide Abdullah, 1973 i & j).

22. *Mandibular mola with fine transverse ridges or not.* Illustrations of the right and left mandibles do show transverse ridges on the mola (although they are not described) and it is hard to decide if they are fine or not in the known Xylophilid larva described by Hyashi (1972: fig. 7). In the case of Anthicidae also, the ridges need to be confirmed.

Fine transverse ridges on mola are definitely found in all known Cephaloidae, Hemipeplidae, Inopeplidae, Nilionidae, Oedemeridae, and Oth-

niidae. They are absent in Boridae, Byturidae, Cisiidae, Colydiidae, Lagriinae-Tenebrionidae, Melandryidae, Monommidae, Mordellidae, Mycetophagidae, Perimylopidae, Prostomidae (? except *Prostomis latoris*), most Tenebrionidae, Tetratomidae, and Zopheridae. Mixed or both characters states are recorded within Pyrochroidae, Pythidae, Salpingidae, Scaptiidae, and Synchroidae (vide Abdullah, 1973 i & j).

23. *Fleshy or setose post-molar appendage and penicillus present or absent.* In the known Xylophilid larva, Hayashi (1972: 109, fig. 7) describes and illustrates a fleshy, hyaline lobe at base below mola (? without penicillus or setae), which corresponds to the fleshy setiferous lobe in most Anthicidae (except *Pergetus*, Eurygeniinae). Post-molar appendages are recorded in Byturidae, and some Scaptiidae but not in other Heteromera whose larvae are known (vide Abdullah, 1973, i & j).

24. *Mandible with or without a retinaculum.* A retinaculum is present in the known Xylophilid larva on the left mandible described as „grinding surface of left mandible strongly projecting at extremity“ (Hayashi, 1972: 109, & fig. 7), as in some Anthicidae (*Anthicus* & *Notoxus* but ? not in *Pergetus* & *Mecynotarsus*) and the following remaining Heteromera: Boridae, some Cephaloidae, a few Colydiidae, some Lagriinae-Tenebrionidae, some Melandryidae, some first instar Meloidae, some Mycetophagidae, Nilionidae, some Othniidae, Perimylopidae, Prostomidae, some Pyrochroidae, some Pythidae, Salpingidae, and some Tetratomidae. A retinaculum is absent in all known Alleculinae-Tenebrionidae, Byturidae, Cisiidae, Hemipeplidae, Inopeplidae, first instar Meloidae, Monommidae, Mordellidae, Oedemeridae, ? Rhipiphoridae, Scaptiidae, Synchroidae, Tenebrionidae (excluding some Lagriinae), and Zopheridae (vide Abdullah, 1973 i & j).

25. *At least one mandible with multi-dentate or multi-lobed cutting edge along inner dorsal margin or not.* Mandibles are tri-dentate apically (particularly the right one) in the known Xylophilid larva. Multi-dentate mandibles are also recorded for ? Anthicidae, Boridae, Byturidae, Hemipeplidae, Othniidae, Perimylopidae, some Pyrochroidae, and Tetratomidae. But not in any known Cisiidae, Colydiidae, Tenebrionidae, Melandryidae, Monommidae, Mycetophagidae, Oedemeridae, Pyrochroidae, Pythidae, Salpingidae, and Zopheridae (vide Abdullah, 1973 i & j).

26. *Maxillary cardo simple or divided.* The maxillary articulating area is bilobed or the cardo is 2-segmented, divided or bi-partite in the known Xylophilid larva, as also in some Anthicidae and following re-

maining Heteromera: Boridae, Byturidae, Cephaloidae, some Hemipeplidae, some Melandryidae, some Mycetophagidae, a few Oedemeridae, some Othniidae, Perimylopidae, some Pyrochroidae, some Pythidae, some Salpingidae, Synchroidae, and Zopheridae. The cardo is, on the otherhand, simple or 1-segmented or undivided in all known Cisidae, Colydiidae, Diphyllidae, Inopeplidae, ? first instar Meloidae, Monommidae, Mordellidae, Nilionidae, Prostomidae, Scaptiidae, Tenebrionidae, and Tetratomidae (vide Abdullah, 1973 i & j).

27. Maxillary mala toothed or not. Mala could be either toothed or provided with an uncus. In my definition, uncus is non-dentate, not separated by a joint, and is a spine or sclerotized hook-like process on the distal inner margin of the maxillary mala perhaps a remnant of lacinia. Hayashi (1972: 109) describes a "bidentate uncus" at inner-distal angle of a rather elongate and basally feebly widened mala in the known Xylophilid larva from Japan, which is not uncus according to the definition but simply a toothed mala. This correction will apply to all descriptions of Japanese coleopterous larvae!

The presence or absence of a toothed mala is known to vary within a genus of Anthicidae. Mala is toothed in all known Oedemeridae, Othniidae, Pyrochroidae, Pythidae and Synchroidae. However, there are no toothed mala in all known Boridae, Cisidae, Hemipeplidae, Inopeplidae, Melandryidae, first instar Meloidae, Monommidae, Mordellidae, Mycetophagidae, Nilionidae, Perimylopidae, Scaptiidae, Tenebrionidae, and Tetratomidae. Both the character states are already recorded for Anthicidae, Byturidae, Cephaloidae, Colydiidae, Prostomidae, Salpingidae, and Zopheridae (vide Abdullah, 1973 i & j).

28. Mala with uncus (non-dentate, spine or hook-like) present or absent. As discussed above, there is really no uncus in the described Xylophilid larva despite the fact that presence of a "bidentate uncus" is reported in the original description (Hayashi, 1972: 109), which simply corresponds to toothed mala. Uncus is absent in *Anthicus floralis*, *A. heroicus*, *Notoxus monoceros* and *Pergetus campanulatus*, and at most is a variable character within a genus of Anthicidae. However, the suggested presence of an uncus in any Anthicid needs to be established, as has been established for Boridae, some Cephaloidae, some Colydiidae, some Melandryidae, some Othniidae, some Pyrochroidae, some Scaptiidae, Tetratomidae, and Zopheridae. Uncus is absent in all known Cisidae, Hemipeplidae, Inopeplidae, first instar Meloidae, Mordellidae, Mycetophagidae, Nilio-

nidae, Oedemeridae, Perimylopidae, Prostomidae, Pythidae, Salpingidae, Synchroidae, and Tenebrionidae (vide Abdullah, 1973 i & j).

29. Ligula present or absent. A prominent ligula is present in the known Xylophilid larva and almost reaches the apex of the labial palp. Among all known Heteromera, the ligula is absent only in Inopeplidae, ? Mordellidae, ? Rhipiphoridae, and some Tenebrionidae (vide Abdullah, 1973 i & j).

30. Gula distinct from submentum and not united, or the two fused. The submentum and gula are united in the known Xylophilid larva and the gular area is not distinct as is also the case in all known Cephaloidae, Cisidae, Colydiidae, Hemipeplidae, Inopeplidae, Melandryidae, Mycetophagidae, Nilionidae, Oedemeridae, Scaptiidae, Synchroidae, and Zopheridae. On the other hand, a gula is present (distinct from submentum) in all known Boridae, Monommiidae, and Perimylopidae. Both the presence and absence of a gula is recorded within the following families: ? Anthicidae, Byturidae, ? first instar Meloidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, Tenebrionidae, and Tetratomidae (vide Abdullah, 1973 i & j).

31. Number of leg segments and claws, normal or less. The leg is 4-segmented and terminates in claw-like tarsunguli in the known Xylophilid larva as well as all known Heteromera, with the following exceptions: Mordellidae (2 or 3 segments, claws absent), and Prostomidae (? 3 segments + tarsungulus in the Japanese *Prostomis latoris*). I may caution here that the coxa or first segment is usually neither illustrated nor counted in the Japanese descriptions, and should also be considered (vide Abdullah, 1973 i & j).

32. Prothorax longer than meso- and meta-thorax or not. The prothorax is usually broader than long in Heteromera, but in Xylophilidae it is definitely narrower than long. It is, however, definitely longer than any other thoracic segment (or head or abdominal segment) — being the longest segment. Prothorax is also longer than meso- and meta-thorax in some Anthicidae, Byturidae, Cephaloidae, Cisidae, Colydiidae, Inopeplidae, Melandryidae, some first instar Meloidae, Monommiidae, Mordellidae, some Mycetophagidae, Nilionidae, Oedemeridae, Othniidae, Perimylopidae, Pyrochroidae, Pythidae, Rhipiphoridae, some Salpingidae, some Scaptiidae, Synchroidae, Tenebrionidae, Tetratomidae, and Zopheridae. On the other hand, all known larvae of the following families have the prothorax shorter to nearly equal than or to meso- and meta-tho-

rax: Boridae, Hemipeplidae, and Prostomidae. Both the character states exist in Anthicidae and others (vide Abdullah, 1973 i & j).

33. Prothorax wider than meso- and meta-thorax or not. The three thoracic segments could be described as nearly equal in the known Xylophilid larva, although the meta-thorax is illustrated to be very slightly wider than the rest. Only the following Heteromera are known to have the prothorax wider than other thoracic segments: some first instar Meloidae, some Salpingidae, and some Tenebrionidae (vide Abdullah, 1973 i & j).

34. Number of abdominal segments 10 or 9. The tenth segment is clearly visible in the anal region in a ventral or lateral view in the known Xylophilid larva as is the case in (at least some) Anthicidae, Boridae, Byturidae, ? Cephaloidae, some Cisidae, some Colydiidae, Hemipeplidae (10th segment recurved within the emargination of 8th sternite!), Inopeplidae, Melandryidae, some Mycetophagidae, Nilionidae, some Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, Scaptiidae, Synchroidae, most Tenebrionidae, Tetratomidae, and Zopheridae. Nine segments are visible in all Cisidae, but only in some members of other families (vide Abdullah, 1973 i & j).

35. Ninth abdominal sternite with or without a transverse row of asperities. There are no such asperities in the known larvae of Xylophilidae, Anthicidae, Boridae, Byturidae, Cephaloidae, Cisidae, Colydiidae, Hemipeplidae, Inopeplidae, Melandryidae, first instar Meloidae, ? Monommidae, Mordellidae, Mycetophagidae, Nilionidae, Perimylopidae, Rhipiphoridae, Scaptiidae, Synchroidae, Tenebrionidae, Tetratomidae, and Zopheridae. These surface roughenings are recorded in the following Heteromera: some Oedemeridae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, and some Salpingidae (vide Abdullah, 1973 i & j).

36. Ninth abdominal sternite composed of a series of small plates or not. The answer is not in Xylophilidae and most known Heteromera except Boridae and possibly also *Mycterus* of Hemipeplidae.

37. Ninth abdominal sternite broad and flat, plate-like or not. Such a broad sternite is known among Heteromera in Boridae, Hemipeplidae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, and Salpingidae but not in Xylophilidae, ? Anthicidae, and others whose larvae we know (such as Byturidae, Cisidae, Melandryidae, Monommidae, Mycetophagidae, Oedemeridae, Perimylopidae, Tenebrionidae, Tetratomidae, and Zopheridae).

38. *Urogomphi* present or absent. *Urogomphi* are present in the known *Xylophilid* larva as well as the following remaining *Heteromera*: *Anthicidae*, *Boridae*, *Byturidae*, *Cephaloidae*, *Cisidae*, *Colydiidae*, *Hemipeplidae*, *Inopeplidae*, some *Melandryidae*, *Monommidae*, some *Mordellidae*, some *Mycetophagidae*, some *Oedemeridae*, *Othniidae*, *Perimylopidae*, *Prostomidae*, *Pyrochroidae*, *Pythidae*, *Salpingidae*, some *Scraptiidae*, *Synchroidae*, some *Tenebrionidae*, *Tetratomidae*, and *Zopheridae*. There are no records of *urogomphi* in all *Nilionidae*, and *Rhipiphoridae*. Within a family (such as *Melandryidae* or *Tenebrionidae*) some members may have the *urogomphi*, while others do not (vide Abdullah, 1973 i & j).

39. *Urogomphi* complex and branched, or simple and un-branched. The only known *Xylophilid* larva has simple *urogomphi*, although they are both branched and simple in *Anthicidae*, *Scraptiidae*, and *Tenebrionidae*. All known *Boridae*, *Inopeplidae*, *Othniidae*, *Perimylopidae*, *Pyrochroidae*, *Pythidae*, and *Salpingidae* have branched *urogomphi*; while only simple *urogomphi* are recorded in all known *Byturidae*, *Cephaloidae*, *Cisidae*, *Colydiidae*, *Hemipeplidae*, *Melandryidae*, *Monommidae*, *Mordellidae*, *Mycetophagidae*, *Oedemeridae*, *Prostomidae*, *Synchroidae*, *Zopheridae*, (to a very slight extent branched in some *Tetratomidae*), and in most *Tenebrionidae* s. 1. (vide Abdullah, 1973 i & j).

40. *Urogomphi* widely separated at base or not. They are widely separated at base in the known *Xylophilid* larva as well as in most *Anthicidae*, *Boridae*, *Cephaloidae*, *Hemipeplidae*, *Inopeplidae*, some *Melandryidae*, some *Mycetophagidae*, *Othniidae*, some *Prostomidae*, *Pyrochroidae*, some *Pythidae*, *Salpingidae*, some *Scraptiidae*, some *Tenebrionidae*, ? some *Tetratomidae*, and *Zopheridae*. (The use of the word "some" in all cases means that the character varies within the family, and both the alternative states are known to exist). The two *urogomphi* are approximate and close together at the base in all known *Byturidae*, *Cisidae*, *Colydiidae*, *Monommidae*, *Mordellidae*, *Oedemeridae*, *Perimylopidae*, and *Synchroidae* (vide Abdullah, 1973 i & j).

41. Tenth abdominal sternite produced into 1 or 2 pseudopods or not. Distinct pseudopods or proleg-like structures are absent in the *Xylophilidae*, *Anthicidae*, *Boridae*, *Cephaloidae*, *Hemipeplidae*, *Inopeplidae*, first instar *Meloidae*, *Monommidae*, *Mordellidae*, *Mycetophagidae*, *Nilionidae*, *Oedemeridae*, *Othniidae*, *Prostomidae*, *Pyrochroidae*, *Pythidae*, *Rhipiphoridae*, and *Synchroidae*. However, they have been recorded in *Byturidae*, some *Cisidae*, some *Colydiidae*, some *Melandryidae*,

some Salpingidae, some Tenebrionidae, and some Tetratomidae (vide Abdullah, 1973 i & j).

42. *Spiracles annular-biforous or simply annular.* The spiracles are simply annular (without chambers on margin) in Xylophilidae, Anthicidae, Cisidae, Hemipeplidae, Inopeplidae (not the thoracic), first instar Meloidae, Mordellidae, some Mycetophagidae, Oedemeridae, Perimylopidae, Prostomidae, Pyrochroidae, some Pythidae, some Salpingidae (not the thoracic), Scaptiidae, and Tenebrionidae. The spiracles are, on the other hand, provided with two side chambers (annular-biforous) in all known Boridae, Byturidae, Cephaloidae, Colydiidae, Melandryidae, Monommidae, Othniidae, Synchroidae, and Zopheridae. In some Inopeplidae and some Salpingidae at least, the thoracic spiracles are annular-biforous and the abdominal spiracles simply annular in the same specimen! (vide Abdullah, 1973 i & j).

43. *Spiracles cribriform or not.* Abdominal spiracles with sieve-like perforations are known (actually or doubtfully — (?) latter in need of verification) among known larvae of the following families only: ? some Pyrochroidae, ? some Pythidae, Salpingidae, most Tenebrionidae, and ? Tricentenotomidae — but not Xylophilidae or Anthicidae (vide Abdullah, 1973 i & j).

44. *Spiracles provided with a series of small peripheral tubes or not.* The answer is "not" for Xylophilidae, Anthicidae and most other Heteromera, and "yes" for Boridae, Cisidae, Hemipeplidae, some Pyrochroidae, some Pythidae, and a few Tenebrionidae only. Future discoveries are expected to add many exceptions to the above-stated conditions of the characters, as well as remove errors and clarify doubts (vide Abdullah, 1973 i & j).

Additional characters of the Japanese *Escalerosia rubrivestis* (Xylophilidae) as mentioned by Hayashi (1972) are:

Head: fronto-clypeus slightly pigmented anteriorly; dorsal surface of head-capsule with a long seta near lateral side behind antenna; antenna with segment 1 transverse, and about $\frac{1}{4}$ as long as segment 2; labrum semicircular; external surface of mandible with 4 to 6 setae, of which one is apparently longer; maxillary palp with segment 3 about $1\frac{1}{2}$ times as long as segment 1 or 2, apical papillae well-developed and one apilla much larger than rest; labial palpi moderately separated from each other basally, apical segment being slightly shorter than basal and with well-developed apical papillae — one of them being much enlarged.

Thorax: pronotum tapering anteriorly at apical third, constricted just before hind angles in dorsal view, laterally with an extremely long seta behind cephalic margin; pre-sternum large, triangular, not reaching to point between pro-coxal cavities — a character in need of comparative study in Heteromera!; legs rather stout, hind legs being longest, coxae widely separated at bases, femora and tibiae with many short setae; claws with setae short and not on the same level.

Abdomen: all segments except 9 smooth, without setae on dorsomedian portion, with 4 setae on lateral half in dorsal view — of which one is much long; segment 8 nearly $1\frac{1}{2}$ times as wide as head or pronotum; segment 9 semi-circular (said to be distinct from Anthicid larvae in shape!), with dorsal and ventral surfaces slightly shagreened, former slightly pigmented, scattered with minute setae, lateral sides roundly convergent to upwardly flexed urogomphi and bearing long setae, excision between urogomphi (hind margin of segment) coloured and broadly rounded; anal region (segment 10) semicircular.

Collection dates: March 30, 1971 (12 specimens) and May 5, 1966 (1 specimen) — vide Hayashi (1972).

Characters of Adults

The primitive and derivative groups and these characters of Xylophilidae (and most families of Cucujoidea and other Coleoptera) remain to be distinguished or discovered and a study like that on Anthicidae (vide Abdullah, 1969, 1971 & 1973 d) is a pre-requisite for possibly solving or discovering the true relationships of Xylophilidae (vide Abdullah, 1973 a). A comparative account of the imaginal characters of Xylophilidae and remaining Heteromera follows now:

1. *M o d e o f l i f e , h a b i t s a n d f o o d.* Xylophilidae are floricolous, adults have been collected on flowers and foliage but we need to learn more about them. Similar habits are recorded in Anthicidae, Byturidae, Cephaloidea, Mordellidae, Oedemeridae, Pyrochroidae, Salpingidae, Scaphitidae, and others within Heteromera. In general, structural similarity despite different modes of life is a stronger indicator of possible phylogenetic relationships between different taxonomic groups than with similar mode of life!

2. *S h a p e.* The known Xylophilids look like ants and are oval to oblong. Ant-like shape has also developed in Anthicidae, particularly in the most derivative group Anthicinae — but Pedilinae, the most primitive sub-

family is not ant-like! Anthicids are elongate, cylindrical or sub-depressed in appearance, and some look like small Meloids or blister beetles.

3. *Size or body-length in mm.* Xylophilids rank among the smallest (1.5—3 mm) in size within Heteromera, the smallest being Cisiidae (0.5—6) and comparable small sized adults are found in Anthicidae (2—13), Colydiidae (1—18), Mordellidae (1.5—15), Mycetophagidae (1.5 to 6), and others. The largest Heteromera being Trictenotomidae (over 50 mm).

4. *Coloration.* Xylophilids are reddish-yellow to dark in colour. Most Heteromera are dark, brown to black although metallic red, green or blue forms exist among Lagriinae-Tenebrionidae, and the prettiest, colourful and bright forms are met within Meloidae. Anthicids are brown or piceous in colour, rarely appearing whitish due to pubescence, and with the legs and ventral body surface rarely partly yellow or rufous.

5. *Vestiture.* Simple or dual (double) type of hairs (short to long) are found in Xylophilidae. Hairs are said to be inserted at the anterior border of the ordinary elytral punctures (? in all Xylophilids), and rarely, there are papillose pads on hind femora of males (absent to reduced in females). Vestiture in Anthicidae is usually sparse, short, and rarely the male has spinous metasternum or legs with ctinidia. Scales or coarse hairs are found in Mordellidae and some Tenebrionidae.

6. *Punctuation (and head surface).* The head surface is punctate to rugose in Xylophilidae. There is a need for precise definition of the terms: fine, coarse, sparse, and dense used for punctures by taxonomists since considerable ambiguity prevails in the existing literature and current practice among specialists.

7. *Head-capsule.* The head is strongly deflexed in Xylophilidae. Partly to strongly deflexed heads are recorded among the remaining Heteromera in Anthicidae, Byturidae, Melandryidae, Meloidae, Mordellidae, Mycetophagidae (slight), Oedemeridae, Pyrochroidae, Rhipiphoridae, and Scaptiidae. In Anthicidae, the head is prognathous to hypognathous.

8. *Type of antenna.* Antennae in Xylophilidae are filiform to sub-serrate, rarely flabellate in male, or with segment 11 very long, or with a small 5-segmented club. In Anthicidae, antennae are usually filiform, although serrate, flabellate, pectinate, sub-clavate or sub-moniliform types are also found. Most Heteromera have clubbed or filiform antennae.

9. *Number of segments in antenna.* There are 11 antennal segments in Xylophilidae and most other Heteromera. Known excep-

tions are recorded in the following families: Anthicidae 11 (rarely 12), Cisiidae 8—10 (11 in *Sphindocis*), Colydiidae 8—11, Dacoderidae 10, Melandryidae 11 (rarely 10), Meloidae 11 (rarely 9 or 8), Oedemeridae 11 (rarely apparently 12 in some males), Pyrochroidae 11 (rarely 12), Rhipiphoridae 11 (rarely 10 in some females), and Tenebrionidae 11 (rarely 10).

10. Antennae inserted under lateral expansions or ridges of frons or not. The answer is "not" in Xylophilidae, Anthicidae, Byturidae, Cisiidae, a few Colydiidae, Dacoderidae, Diphyllidae, Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, Mycetophagidae, Oedemeridae, Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, a few Tenebrionidae, and Tetratomidae. On the other hand, the antennae are inserted under lateral expansions or ridges of frons in Alleculinae-Tenebrionidae, Boridae, Cephaloidae, most Colydiidae, Lagriinae-Tenebrionidae, Monommidae, Mordellidae, ? Scaphitidae, Syndroidae, and Zopheridae. The character has not been described for Merycidae, Pterogiidae, Trictenotomidae, and perhaps Nilionidae.

11. Mandible with the apex pointed, truncate or bifid, etc. The mandible is blunt, emarginate or denticulate in Xylophilidae. They are pointed, truncate, bifid or emarginate in Anthicidae, and are known to vary in the same genus.

12. Maxillary palp with the apical or terminal segment simple or variously modified (securiform, cultriform, dilated, etc). They are large or securiform in Xylophilidae, and are variously modified (dilated, cultriform or securiform) in Anthicidae, which is also the usual thing for most other Heteromera.

13. Labial palp with the apical segment simple or modified (dilated, triangular etc.). The segment is large and oval in Xylophilidae, and simple to dilated or triangular in Anthicidae. Nearly simple to more or less dilated is the usual condition in most Heteromera.

14. Eyes small or large. Both the conditions are described for Xylophilidae, Anthicidae, Meloidae, Pyrochroidae, and others, and in the first family, they are also said to be hairy.

15. Eyes entire or emarginate. Both type of eyes are recorded in Xylophilidae, Anthicidae, Meloidae, Pyrochroidae, and other Heteromera.

16. Eyes finely-faceted or coarsely-faceted. The limit is not always clear in descriptions except perhaps to a "specialist" who

tends to see his or her group out of perspective in relation to the rest of Heteromera or Coleoptera, and expressions like "fine" or "coarse" need to be clearly defined. Both the character states are said to be found within Xylophilidae, Anthicidae, Meloidae, Pyrochroidae, and other Heteromera.

17. Neck wide or narrow. It is well known that Xylophilidae have narrow neck but some or a few of them have wide neck also (vide Arnett, 1971: 754, fig. 4.85). In Anthicidae, the most primitive subfamily (Pedilinae) has wide neck as in Pyrochroidae and the most derivative subfamily (Anthicinae) have them narrow as in Meloidae. Other Heteromera with narrow neck are some Mordellidae, and some Scaptiidae (besides Anthicidae, Meloidae and Xylophilidae).

18. Cervical sclerites present or not recorded. Cervical sclerites are said to be present in almost all Polyphaga and lacking in other suborders which needs to be verified since they do not appear to be described for Xylophilidae, Anthicidae and other families of Heteromera.

19. Pro-coxal or front coxal cavity externally or visibly open or closed. It was once commonly and wrongly thought that the two alternatives may not occur in the same family; increasing knowledge and experience in research have disproved this "conservative" or "traditional" and un-scientific idea — these facts have still not been duly appreciated by many famous and old writers living now.

The pro-coxal cavity is visibly open in Xylophilidae, most Anthicidae, Boridae, Cephaloidae, some or most Cisiidae, a few Colydiidae, Dacoderidae, most Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, Monommidae, Mordellidae, Mycetophagidae, Oedemeridae, some Perimylopidae, Pterogeniidae, Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, Scaptiidae, Syndrionidae, a few Tenebrionidae (? primitive subfamily or groups), Tetratomidae, Trictenotomidae, and a few Zopheridae. On the other hand, the pro-coxal cavity is visibly closed in Alleculinae-Tenebrionidae, a few Anthicidae, Byturidae, some Cisiidae, most Colydiidae, Diphylidae, a few Hemipeplidae, Lagriinae-Tenebrionidae, Merycidae, Nilionidae, Othniidae, some Perimylopidae, Prostomidae, most other Tenebrionidae, and most Zopheridae. Thus, both open and externally closed front coxal cavities are already known in Anthicidae, Cisiidae, Colydiidae, Hemipeplidae, Perimylopidae, Tenebrionidae, and Zopheridae!

20. Pro-coxal cavity internally open or closed. It was once assumed that if the pro-coxal cavity is visibly open, it will also be internally open but this is not true and you need to confirm the internal

closure or opening separately. The front coxal cavity is internally open in Xylophilidae, primitive subfamilies (Pedilinae, Steropinae) of Anthicidae, Alleculinae-Tenebrionidae, Boridae, Byturidae, Cephaloidae, Cisidae, Colydiidae, Diphyllidae, Lagriinae-Tenebrionidae, Meloidae, Merycidae, Monommidae, Mordellidae, Mycetophagidae, Othniidae, Perimylopidae, Pyrochroidae, Pythidae, ? Scaptiidae, some Tenebrionidae, some Tetratomidae, Trictenotomidae, and Zopheridae. On the contrary, the pro-coxal cavity is internally closed in derivative subfamilies of Anthicidae, Dacoderidae, Hemipeplidae, Inopeplidae, Melandryidae, Oedemeridae, Prostomidae, Pterogeniidae, Salpingidae, Synchroidae, some Tenebrionidae, and some Tetratomidae. It may be noted that both conditions are found within Anthicidae, Tenebrionidae, and Tetratomidae.

21. Pro-coxae with or without substantial concealed lateral expansions. Front coxae with such expansions are so far recorded only in Alleculinae-Tenebrionidae, Colydiidae, Dacoderidae, Lagriinae-Tenebrionidae, Merycidae, Monommidae, ? Nilionidae, Prostomidae, Salpingidae, Tenebrionidae, and Zopheridae. They are absent (or not recorded) in Xylophilidae, Anthicidae, Boridae, Byturidae, ? Cephaloidae, Cisidae, ? Diphyllidae, Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, ? Mordellidae, Mycetophagidae, Oedemeridae, Othniidae, Perimylopidae, Pterogeniidae, Pyrochroidae, Pythidae, ? Rhipiphoridae, ? Scaptiidae, and Tetratomidae. Some of the records that are doubtful and need to be verified are indicated with a question mark (?).

22. Pro-coxae transverse and non-projecting or distinctly projecting. The front coxae are distinctly projecting in Xylophilidae, Anthicidae, Cephaloidae, some Cisidae, Dacoderidae, Mycterinae of Hemipeplidae, Melandryidae, Meloidae, Mordellidae, Oedemeridae, Othniidae, Perimylopidae, Pyrochroidae, Pythidae, Rhipiphoridae, Scaptiidae, ? Synchroidae, and a few Tenebrionidae. On the other hand, the pro-coxae are transverse or non-projecting in Alleculinae-Tenebrionidae, Boridae, Byturidae, some Cisidae, Colydiidae, Diphyllidae, some Hemipeplidae, Inopeplidae, Lagriinae-Tenebrionidae, ? Merycidae, Monommidae, Mycetophagidae (could be prominent), ? Nilionidae, Prostomidae, Pterogeniidae, Salpingidae, most other Tenebrionidae, Tetratomidae, Trictenotomidae, and Zopheridae.

23. Pro-coxae separated by a flat intercoxal process with lateral extensions behind coxae or not. The front coxae are not separated in this way in Xylophilidae, some Alleculinae-Tenebrionidae, Anthicidae, Boridae, Byturidae, Cisidae, Colydiidae,

Dacoderidae, ? Diphylidae, Hemipeplidae, Inopeplidae, Lagriinae-Tenebrionidae, Melandryidae, ? Meloidae, Monommidae, Mycetophagidae, ? Nilionidae, Oedemeridae, Othniidae, Perimylopidae, Pyrochroidae, Pythidae, Salpingidae, remaining Tenebrionidae, and Tetratomidae. The procoxae are, however, separated by a flat intercoxal process (with lateral extensions behind coxae) in some Alleculinae-Tenebrionidae, Merycidae, Prostomidae, and Zopheridae, while the character does not seem to have been studied in Cephaloidae, Mordellidae, Nilionidae, Pterogeniidae, Rhipiphoridae, Scaptiidae, Synchroidae, and Trictenotomidae.

24. Pro-coxae externally contiguous or not. They are contiguous in Xylophilidae, some Alleculinae-Tenebrionidae, some Anthicidae, Cephaloidae, some Cisidae, Dacoderidae, some Hemipeplidae, Meloidae, Mordellidae, Oedemeridae, Othniidae, Pyrochroidae, Pythidae, Rhipiphoridae (usually), Salpingidae, and a few Tenebrionidae (un-usually). The front coxae are not externally contiguous in some Alleculinae-Tenebrionidae, some Anthicidae, Boridae, Byturidae, some Cisidae, Colydiidae (widely separate), Diphylidae, some Hemipeplidae, Inopeplidae, Lagriinae-Tenebrionidae, Melandryidae, Merycidae, Monommidae, Mycetophagidae, ? Nilionidae, Perimylopidae, Prostomidae, ? Pterogeniidae, most Tenebrionidae, Tetratomidae, and Zopheridae. I do not recall the condition in Scaptiidae, Synchroidae, and Trictenotomidae.

25. Pro-coxae internally contiguous or not. They are not internally contiguous in Xylophilidae, Dacoderidae, Hemipeplidae, Inopeplidae, Merycidae, Monommidae, Oedemeridae, Othniidae, Perimylopidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, some Tenebrionidae, and Zopheridae. On the other hand, the front coxae are internally contiguous in Boridae, Byturidae, Cisidae, Colydiidae, Melandryidae, Mycetophagidae, some Tenebrionidae, and Tetratomidae. The character remains to be studied in many families including Anthicidae.

26. Prothorax Bostrichoid or not. It is only the family Cisidae where a long and usually humped pronotum with the anterior opening facing more downwards than forwards is found and the prosternum is very short, as develops characteristically (and independently or polyphyletically) in Bostrichoidea (outside Cucujoidea). This means that the prothorax is not Bostrichoid in Xylophilidae, Anthicidae and others.

27. Prothorax with distinct side borders (carinate or explanate laterally) or not. There are no side borders in Xylophilidae, most Anthicidae (all primitive subfamilies), Cephaloidae, Dacoderidae, some Hemipeplidae, Inopeplidae, Lagriinae-Tenebrionidae, Me-

loidae, Oedemeridae, some Perimylopidae, Prostomidae, some Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, and a few Tenebrionidae. However, distinct side borders are found in Heteromera in Alleculinae-Tenebrionidae (borders finely margined), a genus of Anthicidae (rare), Boridae, Byturidae, Cisidae, Colydiidae, Diphyllidae, some Hemipeplidae, Melandryidae, Merycidae, Monommidae, Mordellidae, Mycetophagidae, ? Nilionidae, Othniidae (borders feebly serrate laterally and angles rounded), some Perimylopidae, ? Pterogeniidae, some Pyrochroidae, Scaptiidae, Synchroidae, most Tenebrionidae, Tetratomidae, Trictenotomidae, and Zopheridae.

28. Pronotum apically flanged or not. The pronotum is often narrowed in front in Xylophilidae, but is not apically flanged as is also said to be the case in Alleculinae-Tenebrionidae, Byturidae, Cephaloidae, Monommidae, Mordellidae, Mycetophagidae, and Rhipiphoridae. However, distinctly apically flanged pronotum is met with in some Anthicidae (derivative groups) but not in primitive subfamilies.

29. Pro-pleura with or without deep grooves for receiving antennae. These characteristic antenna receiving grooves are found only in Monommidae, and are not recorded in any other Heteromera.

30. Trochantins of pro-coxae exposed or not. There is no trochantin in front coxae of Xylophilidae, Anthicidae, Cisidae, Colydiidae, Dacoderidae, Diphyllidae, Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, Merycidae, Monommidae, Mordellidae, Othniidae, Prostomidae, Rhipiphoridae, Salpingidae, some Scaptiidae, Tenebrionidae, and Zopheridae. On the other hand, the trochantins of pro-coxae are exposed in Boridae, Byturidae, Cephaloidae, Mycetophagidae, Oedemeridae, Perimylopidae, Pyrochroidae, Pythidae, some Scaptiidae, and Tetratomidae. The condition in Nilionidae, Pterogeniidae, Synchroidae, and Trictenotomidae is not known to me.

31. Trochantins of meso-coxae exposed or not. They are exposed in Xylophilidae, Alleculinae-Tenebrionidae, some Anthicidae (also visible on meta-coxae in some), Boridae, Byturidae, Cephaloidae, Lagriinae-Tenebrionidae, Melandryidae, Merycidae, Mycetophagidae, Oedemeridae, Perimylopidae, Pyrochroidae, Pythidae, Scaptiidae, most other Tenebrionidae, and Tetratomidae. On the other hand, the trochantins of middle coxae are not exposed in some Anthicidae, Cisidae, Colydiidae, Dacoderidae, Hemipeplidae, Inopeplidae, Meloidae, Monommidae, Mordellidae, Othniidae, Prostomidae, Rhipiphoridae, Salpingidae, a few Tenebrionidae, and Zopheridae. The condition is not known in Diphyllidae (where

it could be present as in the related Byturidae), Nilionidae, Pterogeniidae, Synchroidae, and Trictenotomidae.

32. Meso-coxal cavities closed (outwardly by meeting of sterna) or open (by reaching of mes-epimera). The middle coxal cavities are open in Xylophilidae, Alleculinae-Tenebrionidae, Anthicidae (including Cononotidae), Boridae, Byturidae (Crowson, 1967: 93 states, "mes-epimera not reaching middle coxal cavities"), Cephaloidae, Cisidae, Diphyllidae, Lagriinae-Tenebrionidae, Melandryidae, Meloidae, Merycidae, Mycetophagidae, ? Nilionidae, Oedemeridae, Perimylopidae, Pterogeniidae, Pyrochroidae, Pythidae, Rhipiphoridae, Scaptiidae, Synchroidae, most other Tenebrionidae, Tetratomidae, and Trictenotomidae. They are closed in Colydiidae, Dacoderidae, Hemipeplidae, Inopeplidae, Monommidae, Othniidae, Prostomidae, Salpingidae, a few Tenebrionidae, and Zopheridae. The condition is not known to me in Mordellidae and Nilionidae.

33. Meso-coxae completely separated by intercoxal process of sterna or not. Both the conditions are recorded in Xylophilidae but they are only completely separated in Anthicidae (? only narrowly separate), Boridae, Byturidae, Colydiidae, Dacoderidae, Diphyllidae, Hemipeplidae, Inopeplidae, Melandryidae, Merycidae, Monommidae, Mordellidae, Mycetophagidae, Othniidae, Prostomidae, Rhipiphoridae, (usually), Salpingidae, ? Synchroidae, Tenebrionidae, Tetratomidae, and Zopheridae. Middle coxae are not separated in Cephaloidae, Cisidae, Meloidae, Oedemeridae, Perimylopidae, Pyrochroidae, and Pythidae. The condition in Nilionidae, Pterogeniidae, Scaptiidae, and Trictenotomidae is not known to me.

34. Mes-episterna meeting in front of mesosternum or not. They do not meet in Xylophilidae, a few Anthicidae, Boridae, Byturidae, some Cephaloidae, Cisidae, Colydiidae, Dacoderidae, ? Diphyllidae, Hemipeplidae, Inopeplidae, some Melandryidae, Monommidae, Oedemeridae, Othniidae, Perimylopidae, Prostomidae, Salpingidae, Tenebrionidae, Tetratomidae, and Zopheridae. On the other hand, mes-episterna do meet in front of mesosternum in most Anthicidae (including primitive groups), some Cephaloidae, some Melandryidae, Meloidae, Mycetophagidae, Pyrochroidae, and Pythidae. The condition in the remaining families of Heteromera remains to be described.

35. Tarsi 5-5-4 (heteromorous) in both sexes or not (being isomorous — 5-5-5, etc.). The tarsi are 5-5-4 in Xylophilidae (although they may appear 4-4-3) in both sexes. The only

known Heteromera with tarsi other than 5-5-4 are: Byturidae (5-5-5), Cisidae (4-4-4 or rarely 3-3-3), Diphyllidae (5-5-5), Merycidae (4-4-4), Mycetophagidae (4-4-4 or 3-4-4 in male), Prostomidae (4-4-4), and ? very rarely Tenebrionidae. The usual heteromerous 5-5-4 tarsal formulae are found in Anthicidae, Boridae, Cephaloidae, Dacoderidae, Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, Monommidae, Mordellidae, Nilionidae, Oedemeridae, Othniidae, Perimylopidae, Pterogeniidae, Pyrochroidae, Pythidae, Rhipiphoridae, Salpingidae, Scaptiidae, Synchroidae, Tenebrionidae, Tetratomidae, Trictenotomidae, and Zopheridae.

36. Penultimate segment of tarsi simple or lobed below. The penultimate tarsal segments are simple in Xylophilidae, some Alleculinae-Tenebrionidae, Boridae, Byturidae, Cephaloidae, Cisidae, Colydiidae, Dacoderidae, Diphyllidae, Inopeplidae, Melandryidae, Meloidae, Merycidae, Monommidae, Mordellidae, Mycetophagidae, Othniidae, Perimylopidae, Prostomidae, Pterogeniidae, Pythidae, Rhipiphoridae, Salpingidae, some Scaptiidae, Synchroidae, most Tenebrionidae, Tetratomidae, Trictenotomidae, and Zopheridae. The segments are, however, pulvilliform or lobed in some Alleculinae-Tenebrionidae, Anthicidae, Hemipeplidae, ? Lagriinae-Tenebrionidae (segment cordate, with a ventral spongy pad of hairs), Oedemeridae, Pyrochroidae, some Scaptiidae, and very rarely in Tenebrionidae.

37. Ante-penultimate segment of tarsi simple or lobed below. This segment is distinctly lobed in Xylophilidae, Byturidae, Diphyllidae, some Hemipeplidae, very rarely in Oedemeridae, some Pyrochroidae, some Scaptiidae, and only rarely in Tenebrionidae. In all remaining families of Heteromera, they are simple.

38. Tarsal claws simple or modified (being appendiculate, serrate, pectinate, split or with long appendages, etc.). The claws are simple in Xylophilidae, some Anthicidae, Boridae, some Cephaloidae (but with a Meloid-like ventral blade or fleshy appendage), Cisidae, Colydiidae, Dacoderidae, Diphyllidae, Inopeplidae, Lagriinae-Tenebrionidae, Melandryidae, Meloidae (claw with a ventral blade, tooth or spine often with a double row of fine teeth ventrally), Merycidae, Monommidae, some Mordellidae (Meloid-like ventral blade present), Mycetophagidae, Nilionidae, some Oedemeridae, Othniidae, Perimylopidae, Prostomidae, ? Pterogeniidae, some Pyrochroidae (derivative groups), Pythidae, a few Rhipiphoridae, Salpingidae, Scaptiidae, Synchroidae, most Tenebrionidae, Tetratomidae, Trictenotomidae, and Zopheridae. On the other hand, variously modified (and mostly appendiculate) tarsal

claws are found in Alleculinae-Tenebrionidae (pectinate), primitive Anthicidae (appendiculate or rarely split), Byturidae, some Cephaloidae, Hemipeplidae, some Mordellidae (cleft or appendiculate), some Oedemeridae, primitive Pyrochroidae (appendiculate), most Rhipiphoridae (usually bifid or pectinate), and only rarely in Tenebrionidae.

39. Tibial spurs simple or modified (serrate or pubescent). The spurs are simple in Xylophilidae and remaining Heteromera with the following known exceptions: some Melandryidae (serrate), Scraptiidae (pubescent), and Synchroidae (serrate). The spurs are said to be absent in Lagriinae-Tenebrionidae.

40. All trochanters heteromeroid or not (being normal or long). All trochanters are heteromeroid in Heteromera except as follows: Xylophilidae, Hemipeplidae, Inopeplidae, Nilionidae, Perimylopidae (pro-trochanter normal), and Prostomidae.

41. Legs with or without ctenidia or group of spinules. Only rarely, there are pads on posterior femora in males or both sexes of Xylophilidae, and also rarely does one find ctenidia in some males of derivative Anthicidae. In a few Melandryidae, tibiae are found with numerous transverse ridges bearing short spinules; and in some *Epicauta* of Meloidae, anterior femora have sericeous patches. There are apparently no other records.

42. Elytra with or without vein-like ribbings. This feature is present only in Oedemeridae and appears not to be described for Xylophilidae or remaining Heteromera.

43. Elytra with simple or modified apices. Apices of elytra are simple (and not different from rest of elytra or sexually dimorphic) in Xylophilidae and most other Heteromera; the only exceptions being males of some primitive Anthicidae (such as *Pedilus*) and some primitive Meloidae (such as *Protomeloe* Abdullah) — apparently homologous structures showing the phylogenetic link between the two families, the significance of the characters was not appreciated by all earlier workers!

44. Elytra with or without distinct pseudopleura or epipleural fold (separated by distinct pseudopleural carina from remainder of elytra or not). This character has not been clearly stated in many Heteromera, and in Xylophilidae, Anthicidae, Boridae, Cisidae, Dacoderidae, Hemipeplidae, Inopeplidae, Melandryidae, Mycetophagidae, Oedemeridae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, Tetratomidae, and Zopheridae

distinct pseudopleura seem to be absent (while in Byturidae, Colydiidae, Merycidae, Monomidae, and most Tenebrionidae they are apparently distinct or present).

45. *Meta-sternum spinous in the male or not.* As a secondary sexual character, some males of a derivative subfamily (Eurygeniinae) of Anthicidae have spinous metasternum. I am not aware at present of the presence of this character in any other Heteromera including Xylophilidae.

46. *Meta-coxae essentially contiguous or clearly widely separated.* Both types of meta-coxae are found in Xylophilidae, Anthicidae (although in different subfamilies here), Dacoderidae, Perimylopidae, Salpingidae, and Tenebrionidae. However, the hind coxae are reported only widely separated in Colydiidae, and in others they are either contiguous or in need of checking and verification.

47. *Internal keel of meta-coxa long or reduced to a narrow-based apophysis.* The internal keel of hind coxa is long (and described to be "simple" by some authorities) in Xylophilidae, Macratriinae of Anthicidae, Boridae, Byturidae, Cisidae, Colydiidae, some Dacoderidae, some Melandryidae, Merycidae, Monommidae, Mycetophagidae, Oedemeridae, Othniidae, Pyrochroidae, Pythidae, Salpingidae, most Tenebrionidae, Tetratomidae, and some Zopheridae. On the other hand, the keel is short and reduced to a narrow-based apophysis in most Anthicidae, some Dacoderidae, Hemipeplidae, Inopeplidae, some Melandryidae, ? Meloidae, Perimylopidae, Prostomidae, rarely in a few Tenebrionidae, and some Zopheridae. The condition in Cephaloidae, Diphyllidae, Mordellidae, Nilionidae, Pterogeniidae, Rhipiphoridae, Scaptiidae, Synchroidae, and Trictenotomidae remains to be investigated.

48. *Hind-wings with or without sub-cubital flecks.* The metathoracic wings in Xylophilidae, Boridae, Byturidae, Cisidae (fleck divided, rarely apterous), Colydiidae, some Dacoderidae, Melandryidae, Merycidae, Mycetophagidae, Othniidae, Prostomidae, Pterogeniidae, Salpingidae, some Tetratomidae, and Zopheridae have sub-cubital flecks. They are, however, absent in Anthicidae, Cephaloidae, *Dacoderus*, Hemipeplidae, Inopeplidae, Meloidae, Monommidae, Oedemeridae, Pyrochroidae, Pythidae, most Tenebrionidae, and some Tetratomidae. The condition in remaining Heteromera remains to be discovered.

49. *Wings with or without radial cells.* The wing-venation in many families of Heteromera (and other Coleoptera) is still in

need of thorough study; radial cells are described in some Anthicidae (primitive groups), Cephaloidae, Dacoderidae, Diphylidae, Hemipeplidae, Mycetophagidae, primitive Pyrochroidae, Tenebrionidae, and Tetratomidae. They are absent or lost in derivative Anthicidae, Cisidae, Meloidae, Perimylopidae, Pterogeniidae, and derivative Pyrochroidae. The condition in Xylophilidae and remaining Heteromera needs to be described.

50. Wings with or without anal or wedge cell. In the primitive Pyrochroidae, Anthicidae and Meloidae the anal cell is present which is lost in the derivative groups of these families. Anal cell is also recorded in Cephaloidae, Dacoderidae, Diphylidae, Hemipeplidae, Mycetophagidae, Pterogeniidae, Tenebrionidae, and Tetratomidae. There are no anal cells in Cisidae or Perimylopidae, and the condition in Xylophilidae and remaining Heteromera remains to be investigated.

51. Apparent number of anal veins in the main group. The apparent number of anal veins is usually 5 but in Forbes' system (not followed in Crowson's work), the last or fifth one is morphologically 4th A_1 — as I have been describing and illustrating in my past work on Anthicidae and Meloidae. The number below refers to the apparent number of anal veins. Families where less than the usual (5) number is recorded are listed below followed by the apparent number of anal veins: Cisidae, 1 or 0; Meloidae, 4 in some but 5 in primitive groups; Perimylopidae, vestigial; Rhipiphoridae and Stylopidae (latter now placed by me in a new suborder Entomophaga Abdullah — distinct from Polyphaga), are described as resembling Meloidae in venation and generally exhibiting marked reduction as a result of their parasitic mode of life. The condition in Xylophilidae and most other Heteromera remains to be discovered.

52. Mes-endosternite with the arms distinctly branched or not. They are not branched in Xylophilidae, Byturidae, Cisidae, Colydiidae, some Melandryidae, Monommidae, Mycetophagidae, Oedemeridae, Perimylopidae, some Tenebrionidae, and Tetratomidae. On the other hand, the arms of mes-endosternite are distinctly branched in Boridae, Dacoderidae, Hemipeplidae, Inopeplidae, some Melandryidae, Merycidae, Othniidae, Prostomidae, Pyrochroidae, Pythidae, Salpingidae, some Tenebrionidae, and Zopheridae. The character has not been investigated in remaining Heteromera.

53. Type of met-endosternite or furca. I am currently engaged in a revision of the met-endosternite in Coleoptera including Strepsiptera, among other things, and feel that terms used for furca in

Heteromera need explaining. In a non-Hylecoetoid furca, the laminae are lost or reduced, anterior tendons are far apart, median projections is never distinct or very short, and is described for Cisidae (special type), some Colydiidae, ? Dacoderidae, Inopeplidae, Mordellidae, Nilionidae, Pterogeniidae, ? Pythidae, Rhipiphoridae, Scaptiidae, Tenebrionidae, ? Trictenotomidae, and Zopheridae. In a typically Hylecoetoid furca, the arms are free, lamina is extensive, and anterior tendons arise close together and are supported merely by a median thickening of the lamina, (and ? is thought to be primitive for at least some Polyphaga — furcae derived from this type have the anterior tendons separated and median projection lost), as in Anthicidae, Boridae, Cephaloidae, some Colydiidae, ? Hemipeplidae, Melandryidae, Meloidae, Mycetophagidae (varies), Oedemeridae, Othniidae, Pyrochroidae, and Salpingidae. Finally, a Byturid furca is like the Hylecoetoid type but with the lateral parts of the ventral process is anteriorly convex forming a well-developed lamina, the antero-external borders of which are continuous with the front edge of furca, as found in Byturidae, and Xylophilidae. The furcal type in remaining Heteromera needs to be illustrated and described, as well as the above re-examined.

54. Met-endosternite with long or short stalk. The condition in Xylophilidae is not known but since the furca is of the Byturid type, the stalk may be long as in Byturidae. A long stalk is present in most Heteromera whose furcae have been illustrated or described, and short stalk is recorded only in some derivative Anthicidae, Cisidae (almost stalkless), some Dacoderidae, some Perimylopidae, and Zopheridae.

55. Met-endosternite with or without laminae. The laminae are present in Xylophilidae, Anthicidae, Boridae, Byturidae, Cephaloidae, Colydiidae, some Dacoderidae, ? Diphyllidae, Hemipeplidae, some Melandryidae, Meloidae, Merycidae, Monommidae, Mycetophagidae (sometimes reduced), Oedemeridae, Othniidae, Pyrochroidae, Pythidae, Salpingidae, and a few Tenebrionidae. On the other hand, there are no laminae in Cisidae, some Dacoderidae, Inopeplidae, some Melandryidae, Perimylopidae, Prostomidae, Pterogeniidae (very reduced), Rhipiphoridae, Scaptiidae, most Tenebrionidae (meant to include Alleculidae and Lagriidae of older classifications), and Zopheridae. In the remaining Heteromera, the furcae need to be illustrated and described.

56. Met-endosternite with the anterior tendons approximated or far apart. The tendons are approximated in Xylophilidae, Buturidae, (very rarely in) Colydiidae, Diphyllidae, some Hemipeplidae, some Oedemeridae, Rhipiphoridae, and a few Tenebrionidae.

On the other hand, they are far apart or widely separated in Anthicidae, Boridae, Cephaloidae, Cisidae, most Colydiidae, Dacoderidae, some Hemipeplidae, Inopeplidae, Melandryidae, Meloidae, Merycidae, Monommidae, Mycetophagidae, Nilionidae, some Oedemeridae, Othniidae, Perimylopidae, Prostomidae, Pterogeniidae, Pyrochroidae, Pythidae, Salpingidae, Scaptiidae, most Tenebrionidae, Tetratomidae, ? Trictenotomidae, and Zopheridae.

57. Met-endosternite with the anterior tendons arising on the arms or from body of furca (on laminae or at their junction with arms). Both the conditions are found in Anthicidae, Melandryidae, Mycetophagidae and Pythidae. The tendons arise on the arms only in Dacoderidae, Inopeplidae, Merycidae, Monommidae, Nilionidae, Othniidae, Perimylopidae, Prostomidae, Pterogeniidae, Pyrochroidae, Salpingidae, Scaptiidae, most Tenebrionidae, Tetratomidae, and Zopheridae. On the other hand, in Xylophilidae, Boridae, Byturidae, Cephaloidae, most Colydiidae, Diphyllidae, Hemipeplidae, Meloidae, Oedemeridae, Rhipiphoridae, and a few Tenebrionidae, the anterior tendons arise from the body of furca on laminae or at their junction with arms.

58. Met-endosternite with or without an anterior median projection in front of arms. An anterior median projection is present in Xylophilidae, Boridae (not apparent in *Boros schneideri* Panz.), Byturidae, a few Colydiidae (rare), Diphyllidae, Hemipeplidae, Inopeplidae, some Melandryidae, Merycidae, some Pyrochroidae, some Pythidae, Rhipiphoridae, Salpingidae, some Scaptiidae, and some Tenebrionidae. On the other hand, there is no anterior median projection in front of arms in Anthicidae, Cephaloidae, Cisidae, most Colydiidae, Dacoderidae, some Melandryidae, Monommidae, Mycetophagidae, Nilionidae, Oedemeridae, Perimylopidae, Prostomidae, Pterogeniidae, some Pyrochroidae, some Pythidae, some Scaptiidae, some Tenebrionidae, Tetratomidae, and Zopheridae. The condition in remaining Heteromera is in need of investigation.

59. Number of visible abdominal sternites. Five sterna are visible on the abdomen of Xylophilidae and most other Heteromera with the known exceptions stated below: Alleculinae-Tenebrionidae (5 or 6), Anthicidae (rarely 6 in the male), Meloidae (usually 6), Mordellidae (5 or 6), and Salpingidae (5 or 6).

60. Number of connate visible abdominal sternites. All abdominal sternites are free in Heteromera, with the known exceptions being: Xylophilidae (2, i. e. first two visible sternites connate), An-

thicidae (rarely 2 as in a derivative subfamily, Lagrioidinae Abdullah), Hemipeplidae (2—4), Merycidae (3), Nilionidae (3), Perimylopidae (3), Prostomidae (2), Pterogeniidae (2), Tenebrionidae (3), and Zopheridae (3—4).

61. Orientation of tegmen and median lobe in the aedeagus. This character needs to be investigated in sufficient number of males within a family of Heteromera in order to appreciate variation, contancy or usefulness as a character. After examining several thousand aedeagi in Anthicidae in connexion with distinguishing species, I found enormous variation in orientation of tegmen and median lobe, and this may prove to be true in other families also. When the tegmen is dorsal and median lobe ventral in orientation, the aedeagus is said to be of the "normal heteromeroid type" as found in some Anthicidae, Byturidae, some Colydiidae, most Melandryidae, Merycidae, some Mycetophagidae, some Oedemeridae, Othniidae, Perimylopidae, Pythidae, Salpingidae, Scaptiidae, some Tenebrionidae, and Tetratomidae. An "inverted heteromeroid aedeagus" is one where the tegmen is ventral and median lobe or penis dorsal in orientation, as found in some Anthicidae, Boridae, Cisidae, some Colydiidae, Dacoderidae, Hemipeplidae, Inopeplidae, a few Melandryidae, Monommidae, Mordellidae, some Mycetophagidae, some Oedemeridae, Prostomidae, some Pyrochroidae, Rhipiphoridae, some Tenebrionidae, Trictenotomidae, and Zopheridae. In many Anthicidae and Pyrochroidae, I have also found an intermediate condition, where both the tegmen and median lobe are lateral, dorso-lateral or ventro-lateral and quite variable in orientation.

62. Tegmen with the parameres or lateral lobes separate or apically fused in the aedeagus. In the primitive Anthicidae they are separate and in the derivative Anthicidae they are usually fused, so that both conditions are found in a family. The lateral lobes are separate apically in Xylophilidae, some Cisidae, Dacoderidae (setose), Meloidae, Mordellidae, Mycetophagidae, some Oedemeridae, Perimylopidae (setose), some Pyrochroidae, Pythidae, Rhipiphoridae, Scaptiidae, some Tenebrionidae, Tetratomidae, and Trictenotomidae. On the other hand, the parameres are fused throughout in Byturidae, some Cisidae, Melandryidae, Monommidae, some Oedemeridae, Othniidae, some Pyrochroidae, and Alleculinae, Lagriinae and some other Tenebrionidae. Aedeagi in the remaining Heteromera remain to be illustrated and formally described.

63. Median lobe or penis with 2 or 1 median struts in the aedeagus. The median struts are one to two in number in Xylophilidae, Anthicidae, Colydiidae, Oedemeridae, and Tenebrionidae. A single median strut is recorded in Alleculinae-Tenebrionidae, Cisidae, ? Da-

coderidae, Lagriinae-Tenebrionidae, Melandryidae, Meloidae, Monommidae, Mordellidae, Othniidae, ? Perimylopidae, Pythidae, Rhipiphoridae, Scaptiidae, Tetratomidae, and Trictenotomidae. On the other hand, only 2 median struts are said to be found in Byturidae, ? Diphyllidae, Mycetophagidae, and Pyrochroidae. The condition in remaining Heteromera is in need of investigation.

64. Ovipositor long and tubular or short and compact. The ovipositor in many Heteromera including Xylophilidae remains to be studied. The usual condition in Heteromera is the long and tubular ovipositor, and short and compact type is recorded only in a derivative genus of Anthicidae (Eurygeniinae), Cisidae, Meloidae (except possibly the primitive groups such as *Protomeloe*), and a few Tenebrionidae.

65. Ovipositor with the coxite 1- or 2-segmented. Non-segmented coxites are recorded in some Anthicidae, Cephaloidae, ? Dacoderidae, Meloidae, Monommidae, Mordellidae, Oedemeridae, Pythidae and some Tenebrionidae. On the other hand, 2-segmented coxites are found in Alleculinae-, Lagriinae-, and some other Tenebrionidae, some Anthicidae, Cisidae, Melandryidae, Perimylopidae, Pyrochroidae, and Scaptiidae. The condition in remaining Heteromera is in need of investigation.

66. Abdominal appendages present or not. Appendages are present in males of a derivative genus of Anthicidae (Eurygeniinae). Other examples known to me are: abdominal or pubescent fovea in most Cisidae; spinous tubercle on second visible sternite in some males of Mycterinae, Hemipeplidae; and the appendages in *Anaspis* (Scaptiidae). These structures seem to be absent in Xylophilidae and remaining Heteromera.

67. Last abdominal tergite produced into a posteriorly-directed spine or not. This spine is characteristic of Mordellidae, and is not apparently recorded in any other Heteromera including Xylophilidae.

Fossil Xylophilidae

The family has not been formally described as fossils although genera are recorded and listed from the Baltic amber (oligocene to eocene) belonging to *Hylophilus*, *Euglenes* and an un-identified genus near *Euglenes* — all the specimens, however, need to be re-examined and formally described (vide Abdullah, 1964 and 1973 b). The records can not be easily dismissed

as un-authentic on suspicion or prejudice, since the identifications are associated with the good name of a famous German coleopterist, the late E. Reitter, author of the *Fauna Germanica*.

It seems probable that the Baltic amber *Circaeus* Iablokoff-Khnzorian, 1960 claimed in Russia to represent a family Circaeidae Iablokoff-Khnzorian, 1960 of Heteromera (related to Colydiidae and Mycetophagidae) is in fact a member of Phytobaenini of Xylophilidae which remains to be confirmed (vide Abdullah, 1964 and 1973 b) by Russian coleopterists and palaeontologists.

A Key to Distinguish Known Anthicidae and Xylophilidae in the Larval Stage

(add near couplet 9 & 11 in Abdullah, 1973 j)

Orthosomatic in shape, not expanded caudally; coronal suture (part of median epicranial suture) present; hypostomal margins or rods present; 2 ocelli present; mandibles symmetrical or asymmetrical; post-molar appendages present or absent; retinaculum present or absent; maxillary cardo simple or divided; mala toothed or not; ? uncus present in some; pronotum wider than long; urogomphi simple or branched; ninth abdominal tergite not semicircular **Anthicidae.**

Strikingly flattened in shape and markedly expanded caudally; coronal suture absent; hypostomal rods? absent; ocelli absent; mandibles asymmetrical; post-molar appendages present; retinaculum present on left mandible; maxillary cardo divided (or 2-segmented); mala toothed; uncus absent; pronotum narrower than long; urogomphi not branched; ninth abdominal tergite (last body segment in a dorsal view) semicircular with the lateral sides roundly convergent to slender and upwardly flexed urogomphi **Xylophilidae.**

British Xylophilidae

The family in the British Isles is represented by three rather uncommon species of *Aderus* Westwood (including *Xylophila* Lamarck) collected by beating the foliage of trees, in rotten wood, in strawheap, by sweeping, on blossom, in a manure heap, at light, in frass under bark, and in flight, etc. (vide Buck, 1954: 25).

Key to the British Species of *Aderus*

(Buck, 1954)

- 1 Third and fourth antennal segments nearly equal in length, and third not smaller than fourth; dorsal interocular space wide; pronotum not emarginate on sides or at apex 2.

Third antennal segment half or less than half smaller than fourth; dorsal interocular space small or narrow; pronotum laterally emarginate at apex; elytra testaceous and patterned by pubescence 1.75 to 2 mm; southern England to Lancashire)

***Aderus populnea* (Panzer).**

- 2 (1) Elytra with parallel lateral margins in basal half, widened and rounded apically; head and thorax black, elytra testaceous; male antenna filiform and long, eleventh segment produced on one side (2—2.4 mm; southern England to Midlands)

***Aderus pygmaea* (DeGeer).**

Elytra evenly rounded throughout laterally; testaceous to fuscous; male antenna clubbed and short, eleventh segment tapering at apex (1.5 mm; Berkshire, Hampshire & Sussex)

Aderus brevicornis* (Perris).*American and Canadian Xylophilidae**

Some 13 genera and 39 species are already known to occur in North America, the number of species may be even more since the fauna is in need of revision. A systematic revision of North American Xylophilidae will be an internationally acceptable Ph. D. problem for a graduate student as well as the higher classification of the family for the world.

Key to the Genera and Type-species

(Tentative; vide Arnett, 1971)

- 1 Head without tempora and much produced in front of the antennal insertions; body minute in size; (Florida & southern California; 3 species) ***Axylophilus* Casey, 1895.**

Tempora moderate to well-developed, and head not prolonged as above, antennal insertions being anteriorly placed on head 2

- 2 (1) Head with a distinct constriction at base, and with the epistomal suture prominent and deep 3
Head without a constriction at base 12
- 3 (2) Hind leg with first meta-tarsal segment shorter than segments 2—4 combined; (Florida & Texas; 1 species)
Cnopus Champion, 1893
C. impressus (LeConte, 1875).
Hind leg with first or basal meta-tarsal segment clearly longer than segments 2—4 combined 4
- 4 (3) Eyes almost entire to weakly emarginate 5
Eyes deeply and clearly emarginate 10
- 5 (4) Pronotum angulate, angles prominent on sides anteriorly; (Arizona & Florida; 2 species) **Scanylus** Casey, 1895.
Pronotum not as above; eyes with coarse facets 6
- 6 (5) Antenna with segment 3 very long 7
Antennal segments 2 and 3 small; (California, District of Columbia & Indiana; 2 species) **Phomalus** Casey, 1895.
- 7 (6) Pronotum distinctly narrower than head 8
Pronotum and head nearly equally wide or broad; antennal segment 11 abruptly enlarged; (Florida; 1 species)
Ariotus Casey, 1895
A. quercicola (Schwarz, 1878).
- 8 (7) Body elongate, black to piceous, and not spotted 9
Yellow spots on a black and stout body; (Florida & Georgia; 1 species) **Pseudariotus** Casey, 1895
P. notatus (LeConte, 1855).
- 9 (8) Antennal club loose, antennae weakly and gradually incrassate; (Florida, Michigan, New York, Ontario, Pennsylvania, southern California & Wisconsin; 10 species) **Vanonus** Casey, 1895.
Antennal club compact and 5-segmented; antennae distinctly and abruptly incrassate; (Pennsylvania & Wisconsin; 2 species)
Tanilotes Casey, 1895.
- 10 (4) Basal margin of head straight in front of pronotum or head basally truncate; vestiture on body consisting of simple, long and stiff hairs 11
Basal margin of head notched in front of pronotum or head deeply sinuate basally; vestiture dimorphic or dual, matted and short; an-

tennae thick and nearly cylindrical with the apical segment distinctly elongated; (Florida, Illinois, Indiana, Pennsylvania & Virginia; 3 species) **Elonus** Casey, 1895.

- 11 (10) Antennal insertion situated within the emargination of eye; males with flabellate antennae — sexual dimorphism; (Florida, Illinois, Indiana & Pennsylvania; 2 species) **Emelinus** Casey, 1895.

Antennal insertion situated outside the emargination of eye but near it; both males and females with simple antennae — no sexual dimorphism; (District of Columbia, Florida, Indiana, Iowa, North Carolina, Pennsylvania, Rhode Island, South Carolina & Texas; 8 species) **Zonantes** Casey, 1895.

- 12 (2) Head distinctly wider or broader than pronotum; epistomal suture not visible; antennae very long and filiform; body not stout; (Florida; 1 species) **Sandytes** Casey, 1895.

S. ptinoides (Schwarz, 1878).

Head distinctly narrower than pronotum; epistomal suture visible; antennae short; body stout in shape; (Florida, North Carolina & Texas; 3 species) **Ganascus** Casey, 1895.

The type genus (*Aderus* Westwood, 1829; *Euglenes* Westwood, 1829; *Xylophilus* Curtis, 1830) is not found in North America (Arnett, 1971: 756); and *Emelinus* was revised by Werner (*Psyche*, 63: 30—37, 1956), however, much remains to be done.

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